





EARLY RISERS

Portable Bed Phase Three Report

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EXECUTIVE SUMMARY

This report contains a complete overview of Early Risers' Portable Bed design project and the final results of that design project. Much of the information contained in this report regarding the Problem Definition and Concept Generation Phases of the design project will be the same as it was in Early Risers' previous two reports. However, this final report will also include a summary of the team's Modeling and Prototyping Phase. Additionally, any updates to previous elements of the design process conceived during Phase 3 will be reflected here.

During the Problem Definition Phase of the design process, Early Risers selected an engineering problem that it would aim to solve, identified the populations which the solution would cater to, and conducted research on how to best meet those populations' needs. Early Risers sought to create a portable bed system that could be easily transported to and used in any environment, including outdoors. The team conceived of this idea with the intention of aiding the homeless population. In particular it is intended to act as a countermeasure to anti-homeless architecture. Additional research shows that this product can also be used to help other populations in crisis situations, such as victims of natural disasters and patients in overcrowded hospitals. The design also has recreational use among camping enthusiasts. The research Early Risers conducted on these populations led the team to focus on making its final design affordable, compact, and durable above all else.

After completing the Concept Generation Phase, Early Risers has created the final design of its portable bed. The design includes hinges on its legs and the midsection of its main frame that allow it to fold into a more compact shape for carrying. Its legs also include a telescoping function that allows it to adjust to uneven terrain. In order to make the final design as affordable as possible, the materials and part suppliers were chosen in order to minimize production cost without compromising the design's ability to function.

During the Modeling and Prototyping Phase, Early Risers further analyzed its design in order to determine how it will perform. As a part of this process, the team created several mathematical models detailing specific parts of the design. These models analyzed properties of the design such as force and shear stress under a variety of test conditions. The results of these models were then plotted out on graphs using tools such as Microsoft Excel and MATLAB. Following the completion of the models, Early Risers created a working prototype of its design. The prototype differs from the actual design in several key ways. The parts were generated using a 3D printer, and the prototype is an incredibly miniature scale model of the final design. However, it is close enough in function to the final design to provide insight into its performance.

After exhaustive research and analysis, Early Risers has created its final design. The design meets all the customer requirements to the team's satisfaction, and has a favorable financial outlook. Although the design could be improved upon with further revisions, Early Risers is proud of the current iteration and ready to formally present its portable bed.

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INTRODUCTION

Presented with the challenge of creating a product that will improve the condition of life for many people, our team decided to move forward with a portable bed. The team's main motivation was to allow anyone to sleep comfortably wherever needed, driven by researching victimized populations. This included the ever growing homeless population in America where it is common for cities to include anti-homeless architecture instead of helping the poor people. This would involve creating a bed that can be easily transported, folds into a compact shape, and has adjustable legs. The clarification of inspiration is important as it has influenced some of our goals and design requirements for this project.

This report will redefine our problem statement and explain any updates or additions that have been made. In the beginning, the team will describe the customer and market research that was conducted to determine a need for our product. This information outlines our team's motivations and reasonings behind the creation of the design. It will include explaining our original customer requirements and describing how our team's final design meets or did not meet them.

Additionally an explanation of our final design components, including the CAD design, prototype, and analysis will be included. This engineering analysis includes studying the stresses and forces that the design will ensue. After conducting this analysis, our team was able to make educated engineering decisions about where to move forward with the design and what to change.

This description of our analysis will be followed by a comparison of our benchmarks that were chosen during the first stages of our design. Including this will allow us to see how far our design has come and if it really is better than products that already exist. After discussing these steps forward in our design, the report will include the economic analysis of the finalized product. Results of the economic analysis and bill of materials will be presented in a net worth diagram for upper and lower estimated quantities. This will allow the team to give an accurate review on the worth of our product given the cost. It will also give us a visual representation of the viability of our product as we compare the design to previous benchmarks.

CUSTOMER AND MARKET RESEARCH

Our group researched the main stakeholders that would be affected by our product. In America, this is the growing homeless population. There are a little over a half million people suffering from homeless since 2016, with a 30% increase of people without any shelter. This 30%, or 209,000 people, permanently live on the streets (“State.”). They must sleep outside in any weather and are further plagued by the implementation of anti-homeless architecture in some cities. These architectural changes are hostile, do not help the homeless, and are trying to hide the homeless out of sight when they have nowhere else to go. The dilemmas affecting this population are one of our main sources of motivation for this product.

Another source of motivation is the lack of hospital beds that occurred during the COVID-19 pandemic. Due to the hospitals caring for much more people than usual, many went without care and without a bed for a long time. This “bed pandemic” is also fueled by other Natural Disasters like wildfires, flooding, tornados, tropical storms, and winter storms that leave many citizens of America unable to live in their home.

To understand the perspectives of our consumers, our team conducted a survey of students at Purdue. This survey was shared in class group chats and other social media so that our team may get many responses to decipher. This survey resulted in twenty-one responses and as expected, most have not been in the situation where they were unable to lie down due to conditions. The ones that did, however, said that this only ever occurred when they were camping. Because of this, while we are still mainly focusing on the homeless population, we also considered recreational uses for our design.

If you would buy this product, what factors are the most important to you? pick your top 4
 21 responses

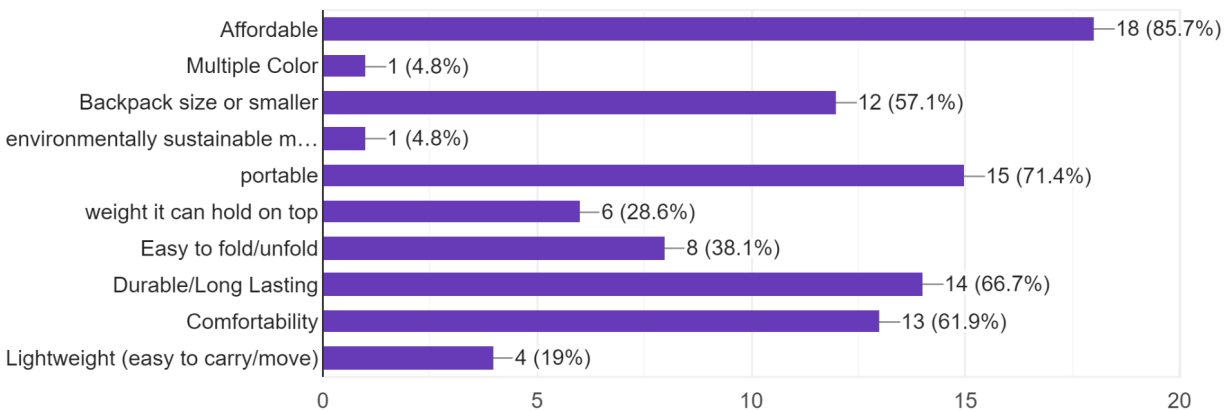


Figure 1. Survey Results

This survey also greatly affected how we choose our customer requirements. We chose the highest ranking requirements from the survey as our requirements which include affordability, if it is portable, and the durability of the product (Figure 3). The rest of these requirements are listed in the House of Quality (Appendix A). The survey and research results greatly affected this creation.

While all of the requirements from the survey were considered to be important to our design, our team analyzed and chose the requirements most important to our design process. We moved forward with these and formulated our engineering specifications using the chosen customer requirements as the base. While customer requirements are qualitative assessments of what our product should be able to accomplish, engineering specifications are quantitative metrics that can be objectively measured. After discussing and choosing these requirements, our team was able to rank and analyze quantitatively the benchmarks that were being compared to our product. In Appendix A, it is clear that the benchmarks did not withhold all of the requirements deemed important, especially in the affordability category.

Completing the research into potential customers and creating a House of Quality allowed our team to understand more clearly what we were attempting to do. This included assigning values to customer requirements so that they may be judged quantitatively, and thus analyzing the benchmarks

with these given values. The team saw the need for an affordable, longer, and water resistant bed, which are all of the categories that the benchmarks failed. We also noticed that none of the benchmarks encompassed all of the requirements at a respectable value. This motivated us to meet the most requirements that we could with a quality design.

PROBLEM DEFINITION REVIEW

No updates were made to the problem definition since our phase two report. The team's design process in phase three was guided almost entirely by our original project definition. In phase one, target values were created and a problem definition was formed from our problem statement, with the use of more specific design criteria. Our research was used to define our consumer and the needs that they have before creating a more refined description of the problem we seek to solve. Early risers then devised the following problem definition in the first phase, and have not made changes to it.

“Early Risers would like to design a folding, portable bed for individuals who are sleeping outside of their home for various reasons. A few of these populations, whom we used as the basis for our personas, include the homeless, victims of natural disasters, and recreational campers. Our goal is to provide these populations with an inexpensive and effective way to be able to sleep anywhere they need to. The idea came from exploring anti-homeless architecture such as bars in the middle of park benches that don't allow the homeless to rest there. Our design makes it easier to sleep where you want; off of the ground, and never without a bed.”

An extremely important part of our problem definition is the populations we're designing it for. Our portable beds are made with the intention to give vulnerable populations a surface to sleep on at night. The homeless, victims of natural disasters, and even campers are believed to be the primary customers of our portable beds, as they were deemed to have the biggest need for the product. The team came to this conclusion based on customer research through the surveys and personas described previously.

The product's design criteria was heavily influenced by the consumer populations discussed. One of our most major design considerations was the compactness of the product once folded. The foldability and compactness were important given the environments our portable bed will be used in.

The problem definition heavily stresses the importance of being able to sleep anywhere someone needs to sleep which is why the compatibility ended up being one of our most important customer needs as gathered from our customer research. Market research also indicated that organizations would most likely be willing to pay around \$20 per unit for the product and that 200,000 units would be sold due to the current shortage just in the United States homeless population of 200,000 beds in homeless shelters. Early Risers aimed to meet the requirements of these organizations and individuals by providing a portable bed that is long lasting, compact, and inexpensive. We met almost every requirement, the exception being in the cost. Our current design will cost much more than what the team intended, and in a future iteration the Early Risers would like to focus on bringing our cost down.

THE DESIGN

The primary function of the final design is to act as a bed that can be carried anywhere and set up in any location. To that end, the design contains two novel performance features. First, the legs have the ability to adjust their lengths. Second, the design is able to switch between its operational state and a compact transportation state. The height adjustment feature is accomplished by constructing the legs from two separate, hollow pieces, one sized so as to slide into the other. These pieces have a series of holes drilled into them at various heights, through which a pin will slide to lock the legs to a specific height.

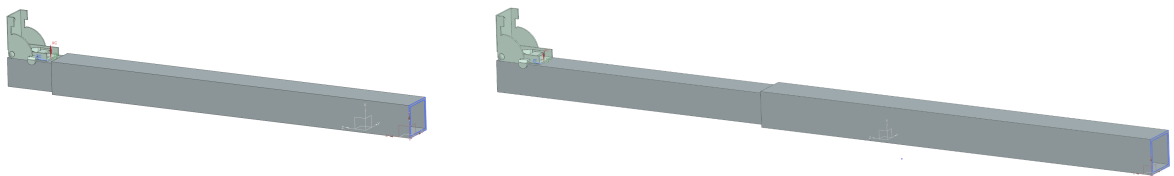


Figure 2: Leg Height Adjustment

The folding feature relies on several hinges attached to the body of the design at specific points. The leg hinges connect the legs to the main frame, and are capable of folding in 90°, which allows the legs to tuck into the body underneath the lip of the frame. The frame hinges are what hold the two pieces of the frame together, and can fold in 180°. Once the legs have folded in, the frame is free to fold in half, greatly reducing the space it takes up when being carried.

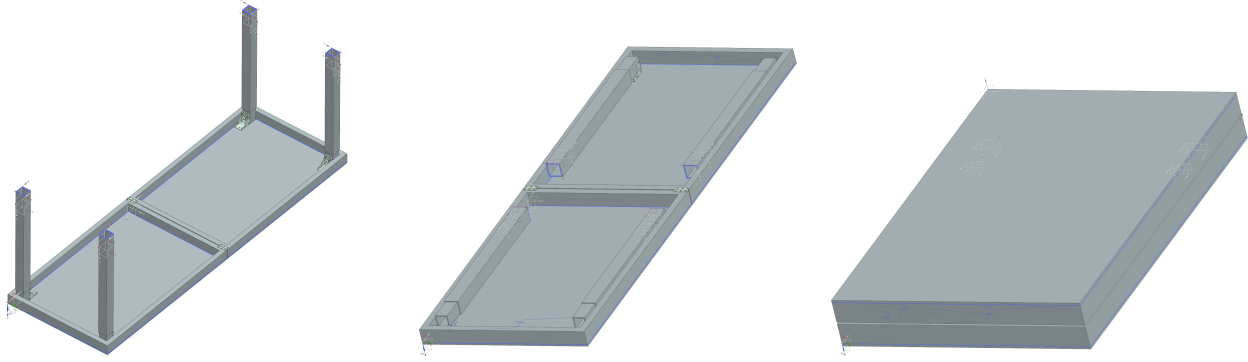


Figure 3: Folding Process

Early Risers' final Bill of Materials (Appendix B) is a comprehensive summary of all the components needed to produce one iteration of the final design. This includes a list of all purchased parts, assemblies, and manufacturing operations used in the design, as well as the listed price of those parts where applicable, and an estimation of the cost when it is not. The Bill of Materials also lists the specific materials each individual part is constructed out of. The cost of the purchased parts made up the largest portion of the total cost of the design. As such, great care was taken to choose the most cost-effective materials for these parts. Some parts, such as the leg hinges, were very unique and could only be found in one place. This meant that their prices were essentially fixed. Most, however, were common enough that Early Risers had several different materials to choose from. In the end, it was decided that hard plastic for the main frame and aluminum for the legs struck the best balance between the design's weight, durability, and cost. While the final total cost of the design is still significantly lower than the team's chosen benchmarks, Early Risers still feels this area could be improved upon in future iterations of the design.

ENGINEERING MODELING

In order to analyze the performance of the final design, Early Risers developed several mathematical engineering models. These are simplifications of aspects of the design that make it easier to calculate key performance factors.

One such model analyzed the shear force experienced by the main frame during use. This model assumes that the force is distributed as a right triangle, and tests the design using a weight of

500 lb/ft. This is significantly higher than anything the design would be expected to endure in day to day use.

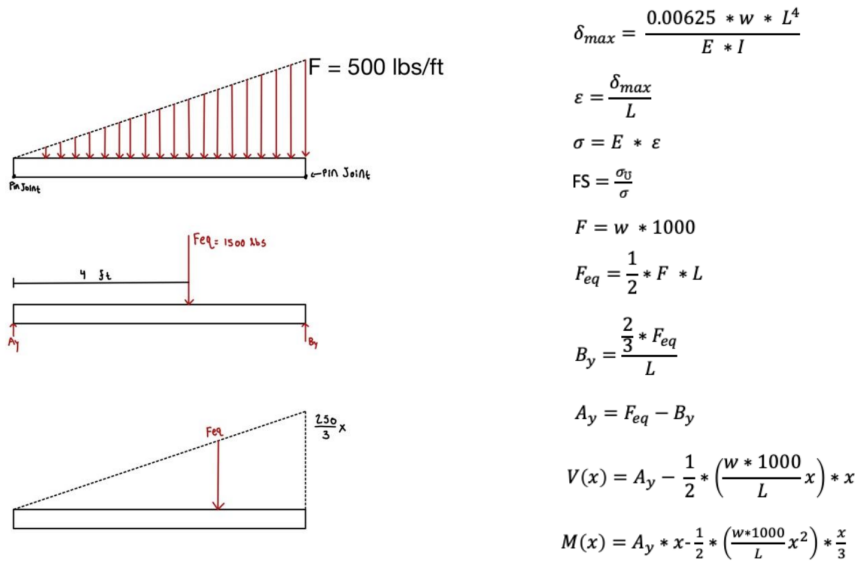


Figure 4: Model 1 and Equations

This model, and the resulting equations, were used to generate the following graphs for shear force and bending moment at various locations along the frame.

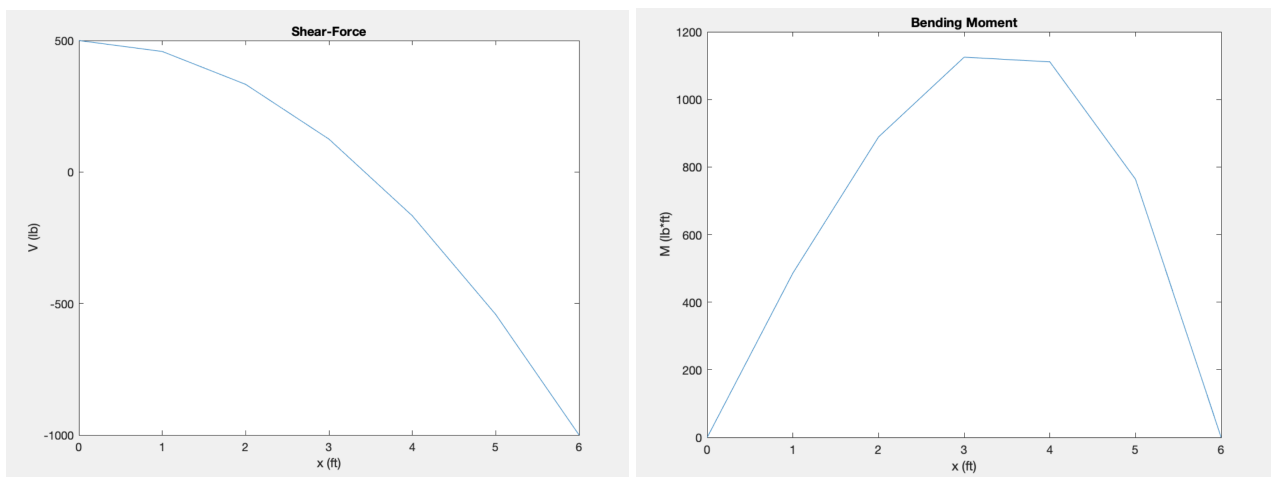


Figure 5: Model 1 Results

Another engineering model was created by Early Risers to analyze the force acting on the frame hinge while the design bears a person's weight. The model consists of a simplified cross-section

of the design, with all the forces on the system idealized to be acting on the hinge joints or the contact point between the two frame pieces.

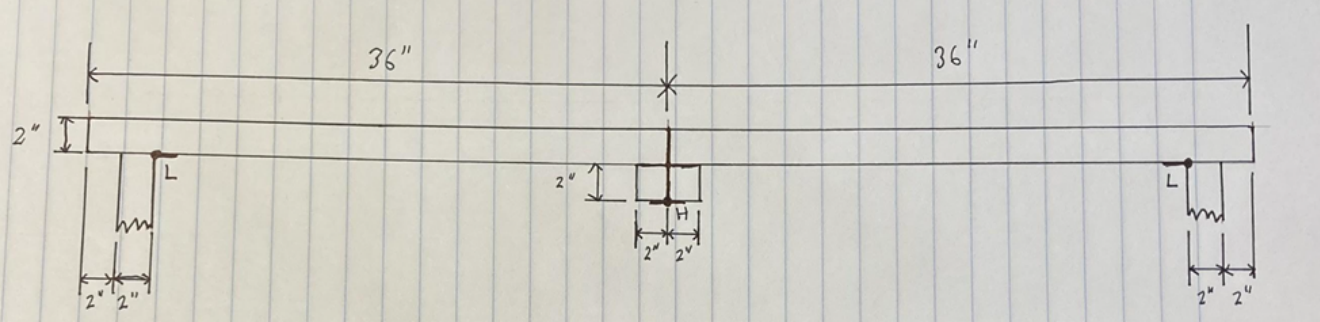


Figure 6: Model 2

Using this idealized model and the assumption that the person’s weight is evenly distributed between the two halves of the design, the forces on the model can be reduced to a simple statics problem calculating the moment about the leg hinge joint.

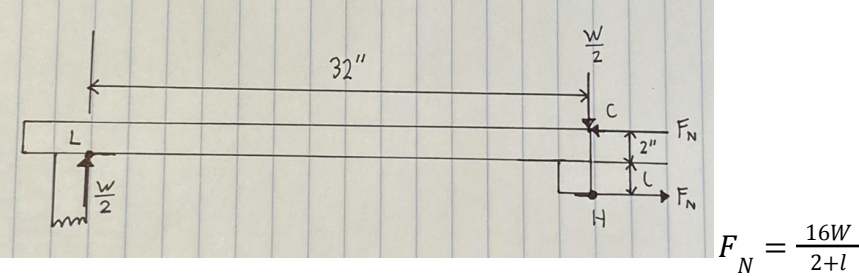


Figure 7: Model 2 Equation

Thus, the force on the frame hinge can be related to the person’s weight and the lip thickness by the above equation. The results of the model are shown on the following graph.

Normal Force (lb)				
Weighth (lb)	Lip Thichness (in)			
	2	3	4	5
90	360	288	240	205.7143
100	400	320	266.6667	228.5714
110	440	352	293.3333	251.4286
120	480	384	320	274.2857
130	520	416	346.6667	297.1429
140	560	448	373.3333	320
150	600	480	400	342.8571
160	640	512	426.6667	365.7143
170	680	544	453.3333	388.5714
180	720	576	480	411.4286
190	760	608	506.6667	434.2857
200	800	640	533.3333	457.1429
210	840	672	560	480
220	880	704	586.6667	502.8571
230	920	736	613.3333	525.7143
240	960	768	640	548.5714
250	1000	800	666.6667	571.4286
260	1040	832	693.3333	594.2857
270	1080	864	720	617.1429
280	1120	896	746.6667	640

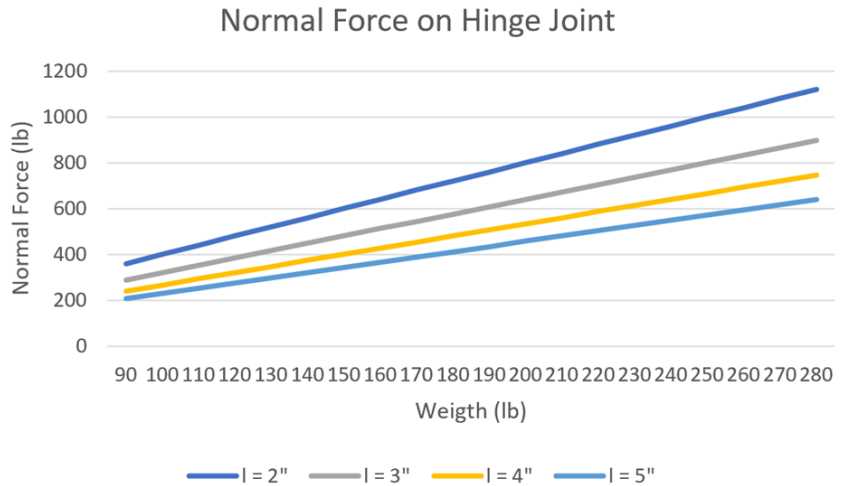


Figure 8: Model 2 Results

PHASE 3 PROTOTYPE

When the final CAD drawings and the bill of materials was up to date, The Early Risers were tasked to determine a feasible solution to create a medium fidelity prototype. Given that all the CAD drawings were scaled to the size of our full size product, it was concluded that certain parts were going to be 3D printed and some were going to be purchased from a hardware store. A total of 10 parts were printed with four inner legs, four outer legs, and two frame pieces with a total manufacturing time of 2 days. Once the parts were printed the sizes of the hinges were able to be determined. Due to the complication of finding hinges that fit our leg specifications, some hinges had to be modified. Every part was attached with super glue to prevent any cracks in the plastic since our prototype was a ¼ scale of our original design.

BENCHMARK COMPARISONS

We researched and conducted analysis on existing products that were similar to our intended design. Specifically, we applied our design requirements to the Coleman Trailhead Cot (“Trailhead™”), the LiteBed™ Folding Bed (“LiteBed”), and Cabela’s Lounge Cot (“Cabela’s”). These competing products satisfy many of the consumer requirements we deemed essential for our intended design. They are comfortable, can be folded down into a compact shape for easy transport, and one that could adjust its height above the ground. However, they are incredibly expensive, especially for our target demographic. This led us to conclude that we had a market niche in creating an affordable alternative to an existing product.

There were not many patents for a portable bed that was very similar to our device. There was one created by Bernhard Junger for a cot that is expired currently. This does not involve adjustable legs, compact design, or is lightweight (Junger). The others included designs of beds who fold into walls, beds on rollers, and other designs very different to ours.

In conclusion it was determined that our design compared to our main benchmarks was better in some areas such as the ability to have adjustable legs that adapt well to difficult terrain. One area our design loses to our competition is the price of our product.

ECONOMIC ANALYSIS

Following the creation of the final design, Early Risers performed an economic analysis to determine several financial characteristics related to mass-production of the design. The analysis was conducted assuming an annual interest rate of 8% and an annual production quantity of 36,400 units, which is similar to the chosen benchmarks. The results of this analysis are shown in Appendix C. Research and development costs are incurred during the first three quarters, with production starting in the fourth quarter. By observing the net worth diagrams derived from the financial analysis, Early Risers determined that the break-even point for the production of its design, where the R&D costs will be completely recouped, occurred between the fourth and fifth quarters. The Return on Investment (ROI), or the ratio of the benefit of investing in Early Risers' design to the initial cost, was calculated to be 33%, and the Rate of Return, the net gain of the investment as a percentage of the initial cost, was determined to be 52.69%.

CONCLUSIONS

Phase 1 of Early Risers' was focused on research, problem definition, and design requirements. Comparatively, Phase 2 was focused on the creation of the design itself. In phase three, the team focused mostly on engineering specifications and carrying out a higher fidelity prototype. During this phase, Early Risers finalized the design and key manufacturing and material choices. The team also conducted engineering model analysis for the components of the final product in order to make sure all engineering specifications were met. Once this occurred, a higher fidelity prototype was made to represent our final design.

The team is extremely satisfied with the final design, however there are things to be improved upon in future iterations. The cost of the final product is one thing that needs to be reduced to meet our original customer requirements. To do this in the future, items will be bought in bulk to save money as the materials were more expensive to build just one. The team will also look into cheaper manufacturing processes and material choices that still provide the same level of quality for the customer. All other specifications were met. The bed folds completely in half so it is easily transportable. Each individual leg adjusts up and down for terrain differences and height adjustment. Our engineering models proved that the bed could hold our target maximum weight of 300 lbs., and the chosen materials can easily sustain weathering and resist water. The final design is something we believe could really help our target population, which was our ultimate goal. The homeless, victims of natural disasters, and anyone else without a bed or even a home, could easily use this product to sleep wherever necessary.

After completing Phase Three, the team has decided that in future iterations the main focus should be lowering the cost of the final product for our consumer. The Early Risers are satisfied with the final design and higher fidelity prototype created, but look forward to making even more improvements in the future.

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https://www.amazon.com/LiteBedTM-Folding-Memory-Foam-Mattress/dp/B09HMZGQ3V/ref=sr_1_1_sspa?keywords=folding%2Bbed&qid=1642684317&sr=8-1-spons&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzME44TFNaWFg1NUFWJmVuY3J5cHRlZElkPUEwMzA4NjIwM0dDQURUSzJVMlIBNyZlbnNyeXB0ZWZlZElkPUEwMTU1NDUzMTdPV1NXM1RENzYWwQz3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU&th=1

“Trailhead™ II Camping Cot,” Coleman.
https://www.coleman.com/camp-furniture/camping-cots/trailhead-ii-cot/SP_271543.html

APPENDICES

Appendix A: House of Quality

House of Quality	Who (Customers)			How (Engineering Specifications)													Now (Benchmarks)		
	Homeless	Campers	Victims of Natural Disasters	Price	Weight	Folded Volume	Supported Weight	Padding	Ability to Fold	Fatigue and Aging	Customer Ratings	Number of Steps to Set Up	Ability to Change Leg Length	Resistance to Water Pressure	Length	Coleman trailhead cot	LiteBed Mattress	Cabela's Lounge Cot	
				Dollars ↓	Pounds ↑	Cubic Feet ↓	Pounds ↑	Y/N ↑	Y/N ↑	Years ↑	# ↑	Steps ↓	Y/N ↑	Psi ↑	Feet ↑				
What(Customer Requirements)																			
Affordable	15	10	20	9	3		3	3	3		1	1	3		3	2	1	0	
Lightweight	8	5	5		9	3									3	4	2	2	
Compact	10	6	7		3	9	1								3	2	2	4	
Safe to Use	5	10	10		3		9		1	9	1	3	3	3		4	4	5	
Comfort	3	12	13				3	9					3		3	3	4	4	
Foldable	6	10	5			3			9	3		1				4	5	4	
Durable	10	10	8				9	3	1	9						2	3	5	
Aesthetics	0	7	2	3				3		1	9				1	5	3	4	
Easy to Operate	10	5	5		1				3			9	3			5	5	3	
Terrain Adaptability	15	10	5		1				3				9			2	1	4	
Water Resistant	10	10	5	1	1			3		9				9		2	3	3	
Universal Length	8	5	15		3	3	1	3	3				1		9	1	3	3	
	100	100	100																
				\$49.99	20.9	5ft^3	300 lbs	Y	Y	1 year	3.1	6	N		6.1 ft.				
				\$179.99	28	4,288 ft^3	350 lbs	Y	Y	3 years	4.6	3	N	N/A	6.2 ft.				
				\$219.99	23	9,471 ft^3	350 lbs	Y	Y	N/A	4.5	8	Y		6.75 ft.				
				\$20.00	15 lb	1 ft^3	300 lbs	Y	Y	10 years	5	4	Y	100 psi	6.5 ft.				
				\$100.00	45 lb	10 ft^3	100 lbs	N	N	1 year	3	15	N	20 psi	5.5 ft.				

Rating Legends	
Now vs. What: 1 -> Does not meet customer requirement. 2 -> Meets requirement slightly. 3 -> Meets requirement somewhat. 4 -> Meets requirement mostly. 5 -> Meets requirement completely.	How vs. What: 0, 1, 3, 9
	Who vs. What: Weights summing to 1

Figure 9: House of Quality Diagram

Appendix B: Bill of Materials

Bill of Materials												
Team Name: Early Risers		Annual Production Quantity		Upper Bound: 36,400								
Project Title: Portable Bed				Lower Bound: 18,200								
Date: 02/22/22												
Item No.	Part No.	Part Name	Units	Qty	Material / Description	Source	Catalog No.	Unit Cost (\$)	Unit Processing Cost (\$)	Assembly Cost (\$)	Line Total Cost (\$)	List Price (\$)
1	A1	Final Assembly	-	1	Final assembly of legs to frame.	-	-	-	-	\$2.50	\$2.50	-
2	A2	Table Assembly	-	4	Attach hinges and lip to bottom of frame.	-	-	-	-	\$1.00	\$4.00	-
3	A3	Leg Assembly	-	4	Attach adjustable legs to hinges with pins	-	-	-	-	\$1.00	\$4.00	-
4	P1	Frame Hinge	pcs	2	2" Brass Surface Mount Hinge	McMaster Carr	1603A7	\$0.89	-	-	\$1.78	\$3.56
5	P2	Hinge screws	pcs	12	Alloy Steel Flat Head Screw (3/8" drive)	McMaster Carr	91792A126	\$0.02	-	-	\$0.19	\$0.06
7	P4	1 3/4" x1 3/4" 1/8" Inner Legs	ft	8	Thick Aluminum Tube	Coremark Metals	6063-T52	\$1.00	-	-	\$7.96	\$3.98
8	P5	2"x2" 1/8" Outer Leg	ft	8	Thick Aluminum Tube	Coremark Metals	6063-T52	\$1.05	-	-	\$8.42	\$4.21
9	P6	Leg Hinge	pcs	4	Bronze Steel	McMaster Carr	18095A51	\$1.29	-	-	\$5.14	\$5.14
10	P7	Leg Hinge Screws	pcs	24	Stainless Steel	McMaster Carr	91783A103	\$0.03	-	-	\$0.62	\$10.40
11	P8	Quick Release Pin	pcs	4	Locks legs to a certain height	Amazon	BQV-002	\$0.75	-	-	\$3.00	\$3.00
12	P9	Cam Nuts	pcs	4	6-3z nuts used for cam handle	McMaster Carr	90257A007	\$0.02	-	-	\$0.08	\$0.08
13	P10	Strap	in/3	1	Feed-Through Buckle; keeps bed folded	McMaster Carr	8854T121	\$2.93	-	-	\$2.93	\$10.93
14	P11	0.25"x2x4" Frame	pcs	2	HDFE Sheet	USPlastic	46578	\$5.22	-	-	\$10.44	\$20.87
15	M1	Hinge Lip	pcs	1	2" Thick Plastic Lip	McMaster Carr	6644N37	\$0.39	-	-	\$0.39	\$0.31
16	M2	Hinge Bottom Holes	-	8	Drill hinge mounting holes in frame.	-	-	-	\$0.25	-	\$2	-
17	M3	Leg Mounting Holes and Hole for Leg	-	12	Drill legs mounting holes and locking holes.	-	-	-	\$0.25	-	\$3	-
18	M4	Drill Holes in Legs	-	4	Drill slot on inside leg to enable locking.	-	-	-	\$0.25	-	\$1	-
19	M5	Cut Legs	-	8	Cut Legs into 1 ft length.	-	-	-	\$0.25	-	\$2	-
20	M6	Trim Frame	-	2	Cut Frame to 2x3'	-	-	-	\$0.25	-	\$1	-
21	M7	Cut Lip	-	4	Cut Lip Pieces to 3"	-	-	-	\$0.25	-	\$1	-
Total Purchased Parts \$											\$40.57	
Total Custom Manufactured Parts \$											\$10	
Total Assembly Cost \$											\$10.50	
Total Cost \$											\$60.96	

Figure 10: Bill of Materials

Appendix C: Financial Analysis Diagrams

INPUT				CALCULATED			
Interest Rate/ year=	8 %	Interest Rate per Period=	0.02 rate/period				
Analysis Period/ year=	4 #	Estimated Mfg. Cost=	134.13 \$				
Tooling and Fixtures=	202.5 10 ³ \$	Retail Price=	516.52 \$				
Annual Production=	36.4 10 ³ \$	Build per Period=	9.1 10 ³ \$ #				
Estimated Cost of Purchased Part=	103.83 \$	Total Program Build=	109.2 10 ³ \$ #				
Estimated Cost of Fabricated Part=	8 \$	Total Retail Sales=	16,589,964 (10 ⁶) \$				
Estimated Assembly Cost=	22.1 \$	Return to Project=	17,676,952 (10 ⁶) \$				
R&D Cost=	76,154 10 ³ \$	Net Present Value=	2166.1 10 ³ \$ \$				
Cost. % of Retail=	25 %	No Interest Present Value=	2650,7452 10 ³ \$ \$				
Return to Project. % of Retail=	30 %						

	Quarters															Sum
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
R&D Costs (10 ³ \$)	88.077	88.077	0	0	0	0	0	0	0	0	0	0	0	0	0	76.154
Tooling & Fixtures (10 ³ \$)	0	101.25	101.25	0	0	0	0	0	0	0	0	0	0	0	0	202.5
Production (10 ³ \$)	0	0	0	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	109.2
Cost of Production (10 ³ \$)	0	0	0	1220.583	1220.583	1220.583	1220.583	1220.583	1220.583	1220.583	1220.583	1220.583	1220.583	1220.583	1220.583	14646.996
Plant "Sales" (10 ³ \$)	0	0	0	1464.6996	1464.6996	1464.6996	1464.6996	1464.6996	1464.6996	1464.6996	1464.6996	1464.6996	1464.6996	1464.6996	1464.6996	17576.3952
Sales Minus Cost (10 ³ \$)	0	0	0	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	2929.3992
Net for Quarter (10 ³ \$)	-88.077	-139.327	-101.25	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	244.1166	2650.7452
Net Worth (10 ³ \$)	-88.077	-177.404	-278.654	-54.5374	209.5792	453.6958	697.8124	941.929	1186.0456	1430.1622	1674.2788	1918.3954	2162.512	2406.6286	2650.7452	15203.1118
Present Value (10 ³ \$)	-97.3	-133.9	-95.4	225.5	221.1	216.8	212.5	208.4	204.3	200.3	196.3	192.3	188.7	185.0	181.4	2166.1
Net Worth Present Value (10 ³ \$)	-97.3	-171.2	-266.7	-41.1	180.0	396.7	609.3	817.6	1021.9	1222.1	1418.5	1611.0	1799.7	1984.7	2166.1	12731.1

Break-Even Point	6th	quarter
Profit	976.4664	(10 ³)\$
Net Present Value	2166.1	(10 ³)\$
(ROI)	33	%
(ROPI)	52.6942	%
Min Production Without Interest	4.9	(10 ³)\$
Min Production With Interest	5.1	(10 ³)\$

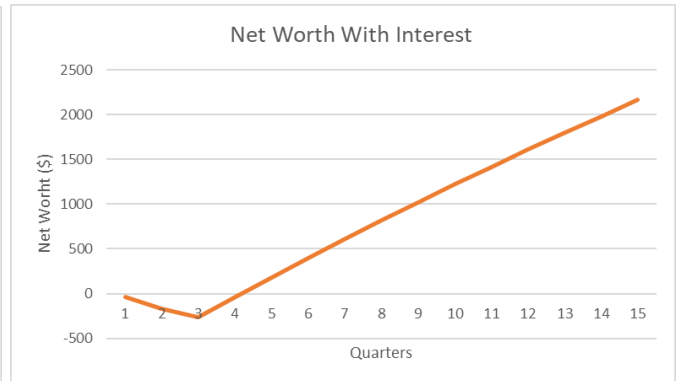
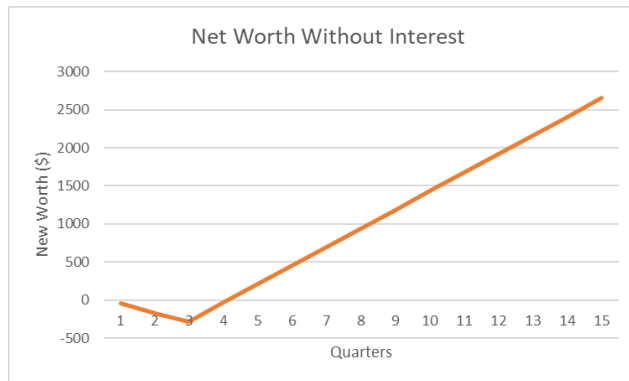


Figure 11: Financial Analysis and Net Worth Diagrams